

### CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

- 1           1.       A modified hybrid for an analog front end, comprising:  
2               a fixed portion configured to match an effective impedance of a transmission line  
3               as seen at the analog front end and to generate a filtered replica of a local transmit signal;  
4               and  
5               an adaptive portion containing a plurality of controllable circuit elements arranged  
6               to form a biquad and a summer to produce a transfer function configured to compensate  
7               for transmission line irregularities, wherein the adaptive portion receives the filtered  
8               replica of the local transmit signal and mathematically combines weighted signal  
9               components with a duplex signal to recover a remotely generated receive signal in a  
10              single operation at a hybrid amplifier.
- 1           2.       The hybrid of claim 1, wherein the fixed portion comprises passive circuit  
2               elements.
- 1           3.       The hybrid of claim 1, wherein the adaptive portion is implemented on an  
2               integrated circuit.
- 1           4.       The hybrid of claim 1, wherein the biquad and the summer are  
2               implemented via a balanced differential circuit configuration.
- 1           5.       The hybrid of claim 1, wherein the adaptive portion transfer function is  
2               modified to compensate for a bridged tap induced frequency notch.
- 1           6.       The hybrid of claim 1, wherein the signal components comprise a band  
2               pass output a low pass output.

1           7.     The hybrid of claim 2, wherein the passive circuit elements are selected  
2     and arranged to match the impedance of the combination of a standard isolation  
3     transformer associated with a local loop.

1           8.     The hybrid of claim 5, wherein the bridged tap induced frequency notch  
2     comprises a range of frequencies where the phase of the local transmit signal exceeds a  
3     threshold beyond which the hybrid fails.

1           9.     The hybrid of claim 6, wherein the signal components are weighted in the  
2     summer by controllable impedances.

1           10.    An improved analog front end, comprising:  
2     means for receiving a duplex signal transmission;  
3     means for matching the effective impedance of a transmission line as seen at the  
4     analog front end in the absence of transmission line irregularities; and  
5     means for adaptively compensating for at least one bridged tap induced frequency  
6     notch in the transfer function identifying the analog front end.

1           11.    The analog front end of claim 10, wherein the means for receiving  
2     comprises a hybrid.

1           12.    The analog front end of claim 10, wherein the means for matching  
2     comprises a fixed portion of a hybrid.

1           13.    The analog front end of claim 10, wherein the means for adaptively  
2     compensating comprises a biquad and a summer.

1           14.    The analog front end of claim 12, wherein the fixed portion of the hybrid  
2     comprises a passive network of discrete devices.

1           15.     The analog front end of claim 13, wherein the biquad and a summer  
2     comprise a plurality of controllably selected circuit elements having various fixed  
3     impedances.

1           16.     The analog front end of claim 15, wherein the plurality of controllably  
2     selected circuit elements comprise elements selected from the group consisting of  
3     integrated circuit resistors, capacitors, and transconductors.

1           17.     A transceiver, comprising:  
2             an analog front end having a modified hybrid comprising:  
3             a first portion configured to match the effective impedance of a transmission line  
4     as seen at the analog front end in the absence of transmission line irregularities and to  
5     filter a duplex signal; and  
6             a second portion implemented on an integrated circuit, the second portion  
7     configured to receive the filtered duplex signal and adaptively compensate for at least one  
8     transmission line irregularity observed in the absence of a remote signal transmission.

1           18.     The transceiver of claim 17, wherein the second portion is adaptively  
2     controlled to compensate for at least one transmission line irregularity reflective of  
3     environmental conditions surrounding the transmission line.

1           19.     A method for configuring a local transceiver to minimize the transmit  
2 power required at a remote transmitter, comprising:  
3           applying a locally generated transmit signal to an improved front end in the  
4 absence of a remote signal, the front end containing a hybrid having a balance network  
5 further comprising a fixed portion and an adaptive portion;  
6           optimizing the transmit signal power;  
7           recording a reflected version of the optimized transmit signal in a receive path;  
8           applying the adaptive portion of the balance network when indicated by at least  
9 one characteristic associated with the reflected transmit signal;  
10          controllably adjusting the adaptive portion of the balance network to minimize the  
11 amplitude of the reflected version of the transmit signal in the receive path; and  
12          notifying a remote transceiver to initiate a self-directed transmit signal power  
13 optimization scheme.

1           20.     The method of claim 20, wherein the step of applying comprises supplying  
2 the locally generated transmit signal to a fixed portion of a hybrid configured to match the  
3 effective impedance of a transmission line as seen at the improved front end.

1           21.     The method of claim 20, wherein controllably adjusting comprises  
2 performance of a steepest descent algorithm.

1           22.     The method of claim 20, wherein controllably adjusting comprises  
2 performance of a recursive least squares (RLS) algorithm.

1           23.     The method of claim 20, wherein the step of applying the adaptive portion  
2 of the hybrid is responsive to at least one transmission line characteristic reflective of a  
3 bridged tap associated with the transmission line.

1           24.     A method for recovering a remotely generated signal from a transmission  
2 line in a duplex signal communication system, comprising:  
3           applying a locally generated transmit signal to an improved front end in the  
4 absence of a remote transmit signal, the front end containing a hybrid having a balance  
5 network further comprising a fixed portion and an adaptive portion;  
6           recording a reflected version of the optimized transmit signal in a receive path;  
7           controllably adjusting the adaptive portion of the balance network to minimize the  
8 amplitude of the reflected version of the locally generated transmit signal in the receive  
9 path; and  
10          combining a scaled replica of the locally generated transmit signal with a plurality  
11 of adaptive portion outputs and a duplex signal on a transmission line to recover a  
12 remotely generated receive signal from the transmission line.

1           25.     The method of claim 24, wherein the step of applying comprises supplying  
2 the locally generated transmit signal to a fixed portion of a hybrid configured to match the  
3 effective impedance of a transmission line as seen at the improved front end.

1           26.     The method of claim 24, wherein controllably adjusting comprises  
2 performance of an optimization algorithm.

1           27.     The method of claim 26, wherein the optimization algorithm is selected  
2 from the group consisting of a steepest descent algorithm and a recursive least squares  
3 (RLS) algorithm.

1           28.     The method of claim 26, wherein the step of combining comprises  
2 weighting and mathematically combining signal components with the receive signal in a  
3 single operation at a hybrid amplifier.